APPENDIX E
FLOOD IMPACT STUDY

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TECHNICAL MEMORANDUM

TO:	Will Burns, David J. Powers and Assoc.	DATE:	December 23, 2016
FROM:	Sarah Rahimi, PE Justin Maynard, PE	JOB#:	DPOW.95.16
SUBJECT:	East Tasman Area Floodplain Impact Study		

APPROACH TO ANALYSIS

This impact evaluation for the East Tasman Area Development in Santa Clara identifies the hydrologic and hydraulic impacts of the proposed development compared to existing conditions. This study utilizes an expanded a coupled MIKE URBAN & MIKE FLOOD analysis previously completed by Schaaf & Wheeler for the City of Santa Clara Storm Drain Master Plan. Impacts of the proposed development are found to be either "less than significant" or "less than significant with mitigation incorporated".

THRESHOLDS OF SIGNIFICANCE

Appendix G of the CEQA Guidelines and the Regulatory Setting requirements considers the proposed project to have a significant environmental impact with regard to hydrology if it would:

- Impact 1: Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- Impact 2: Place within a 100-year flood hazard area structures that would impede or redirect flood flows;
- Impact 3: Alter existing drainage patterns, including streams and rivers, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding inside or outside of the plan area;
- Impact 4: Alter existing drainage patterns, including streams and rivers in a manner that would result in significant erosion inside or outside of the plan area;
- Impact 5: Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- Impact 6: Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam; or
- Impact 7: Expose people or structures to inundation by seiche, tsunami, or mudflow.

PROJECT LOCATION

The project area is located within an existing 36-parcel, 46-acre light industrial and commercial neighborhood bounded by Tasman Drive to the south, the Guadalupe River to the east, the Santa Clara Golf Club to the north, and Lafayette Street to the west (Figure 1). The Specific Plan area is adjacent to the Lick Mill Light Rail Transit station on Tasman Drive and the Great America Station on the west side of Lafayette Street, which is served by both the Altamont Commuter Express (ACE) and Amtrak.

PROJECT DESCRIPTION

The site is designated in the 2015-2025 Phase of the General Plan for High Density Residential land use. Parcels in the Specific Plan area are zoned for ML – Light Industrial zoning district. The City proposes a Specific Plan to create a framework for the development of a high density transit-oriented neighborhood with supportive retail services. The Specific Plan would allow development of up to 4,500 dwelling units and up to 106,000 square feet of retail space including a 25,000 square foot grocery store. Residential densities in the Specific Plan area would range from a minimum of 60 dwelling units per acre (du/ac) on sites less than two acres in size to a minimum of 100 du/ac for sites larger than two acres. Buildings in the Specific Plan area would be, at maximum, 220 feet in height.

The Specific Plan would maintain the existing roadway network and vehicular connections to Tasman Drive and Lafayette Street. Lick Mill Boulevard would be extended through the site to connect with the existing roadway network and City Place (current Santa Clara Golf Club) to the north. The right-of-way on Calle de Luna would be widened to accommodate sidewalks. An extension of Calle del Sol within the Specific Plan area, from Calle de Luna to Calle del Mundo, would also provide an additional north/south connection. Public open space within the plan area is planned for a minimum of four acres. Connections from planned open space areas and pathways to the adjacent City Place development and levee along the Guadalupe River are proposed. The plan also includes the possible culverting of the drainage ditch on private property at the toe of the Guadalupe River levee.

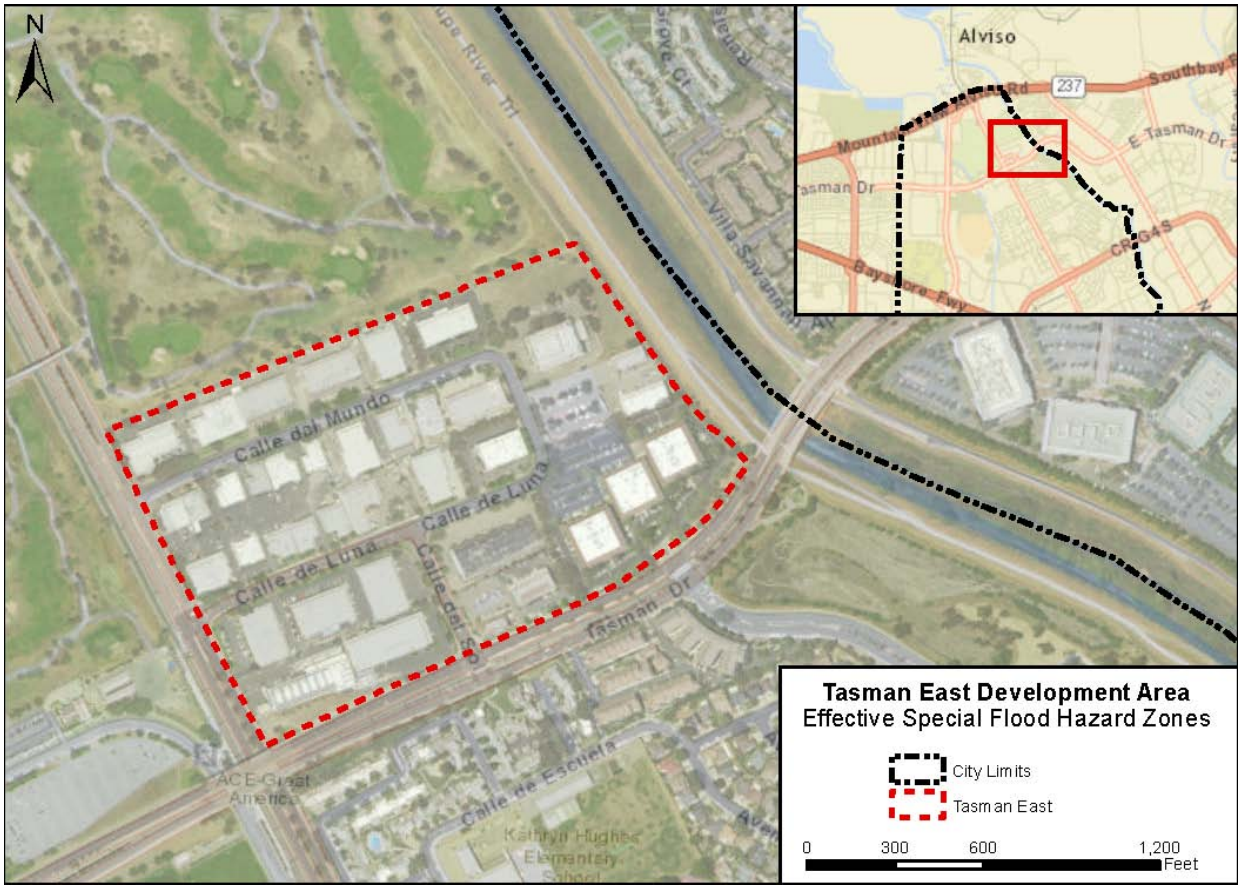

Figure 1. Vicinity Map Shown with Project Site

PROJECT IMPACTS AND MITIGATION MEASURES

Impact 1: Place housing or structures within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map.

Finding: Less than Significant with Mitigation Incorporated

Per the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) number 06085C0062J, effective February 19, 2014, the majority of the project site is located in special flood hazard area (SFHA) Zone AH (Elevation 8 feet NAVD), designating an area subject to inundation by one-percent-annual-chance shallow flooding (usually ponding) with average depths of one to three feet. The rest of the site is designated as Zone X (shaded), with one-percent flood risk reduced by levees. The FEMA FIRM indicates the ponded (Zone AH) flooding effect is entirely due to a lack of capacity in the local drainage systems, as the nearby Guadalupe River is contained by accredited levees and drainage to the river is managed by the downstream Eastside Pump Station, which is owned and operated by the City of Santa Clara. Developed lands located adjacent to the project site have been designated primarily as Zone X, with Lafayette Street designated as Zone AO (1) (shallow sheet flow with 1 foot average depth), and the drainage swale at the toe of the levee to the east of the site designated as Zone AH (Elevation 6 feet NAVD). Lafayette Street's Zone AO (1) designation is also based on a lack of local storm drain system capacity. The FEMA SFHA designations are shown on Figure 2. Note that the downstream Eastside Pump Station is not shown; the annotated Tasman Pump Station discharges runoff from a small local area into the storm drain system.

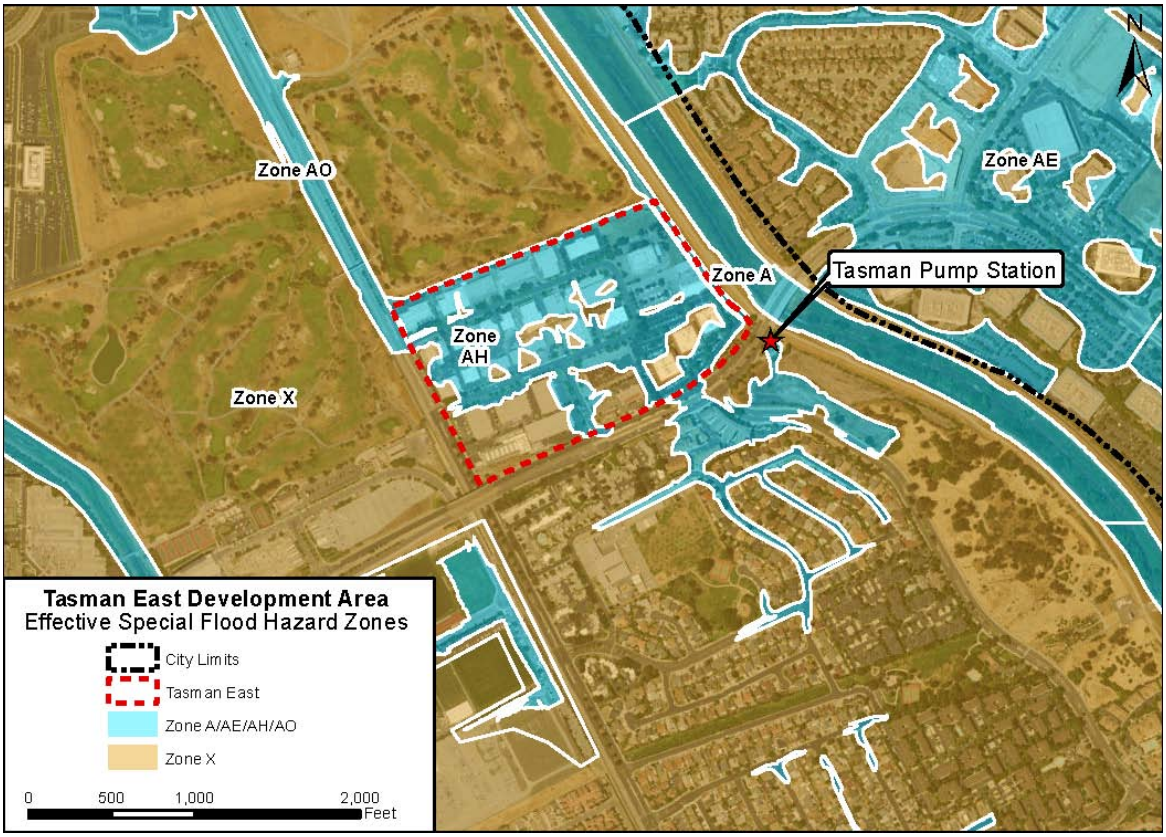

Figure 2. FEMA Floodplain Map

To remove a building from the FIRM via a Letter of Map Revision Based on Fill (LOMR-F), FEMA requires that the lowest grade adjacent to each structure that is removed from the SFHA be greater than the Base Flood Elevation (BFE), which is the estimated 100-year (one-percent) water surface elevation. This option applies to both residential and commercial structures. Additionally in an AH Zone, to meet National Flood Insurance Program (NFIP) regulations, the lowest floor of the residential structure must be elevated at or above the 100-year BFE. For commercial buildings in the floodplain, floodproofing of non-residential buildings may be permitted as an alternative to elevating the building to or above the BFE. As part of floodproofing, a floodproofing design certification is required as well. Commercial structures can also opt to be removed from the floodplain through the placement of fill.

The project has a ***Less than Significant Impact with Mitigation Incorporated*** because as part of the project, structures will be elevated as necessary using fill to remove those structures from the SFHA via the LOMR-F application process.

Impact 2: Place housing or structures that impede flood flows in a 100-year flood hazard area.
Finding: Less than Significant with Mitigation Incorporated

To remove the project site from the SFHA, the area will be graded so that all the building pads will above the Base Flood Elevation. For offsite flood elevations to be increased, this grading and building construction would have to block the active conveyance of flood flows through the project site. Furthermore, to meet the NFIP, the project cannot incur more than one (1) foot of cumulative impact to the floodplain.

Potential impacts caused by proposed project grading have been investigated using the results of the MIKE URBAN 1D storm drain system model, coupled with a MIKE FLOOD 2D overland model developed for this area. This model represents the best available floodplain information for the site. However, this may not be the same as the effective FEMA FIRM in the area, which, while dated February 19, 2014, relies on outdated data from the 1970s and 1980s. The updated hydrology and hydraulics that form the basis of the coupled 1D & 2D models have not been submitted to, approved or adopted by FEMA; although they have been reviewed by the City of Santa Clara and Santa Clara Valley Water District (SCVWD).

The storm drain system serving the development area is not directly connected to surrounding systems and generally receives only local drainage. Surface runoff to the project site from the surrounding area is limited to Lafayette Street and Tasman Drive, although some overflow from the existing storm drain system on Lafayette Street enters the area from the northwest. The system drains to an open swale to the east, combining local gravity drainage and discharges from the Tasman Pump Station. In the existing condition during a one-percent storm event, stormwater runoff is unable to enter the storm drain system due to a lack of capacity, which causes the storm drain system to surcharge (pressurize) and force water out of the storm drain system through the open inlets and catch basins. Flooding from these stormwater spills is mostly contained within the street rights of way, and some overland flow enters the project site from Lafayette Street from the northwest. Existing condition water surface elevations and areas of flooding estimated using the model are shown in Figure 3.

The extent of flooding shown in Figure 3 differs from the effective FIRM (Figure 2) primarily because the flood hazard analysis and mapping used to prepare the Santa Clara SDMP is more detailed and precise than the analysis and mapping used to map the interior residual floodplain shown on the FIRM.

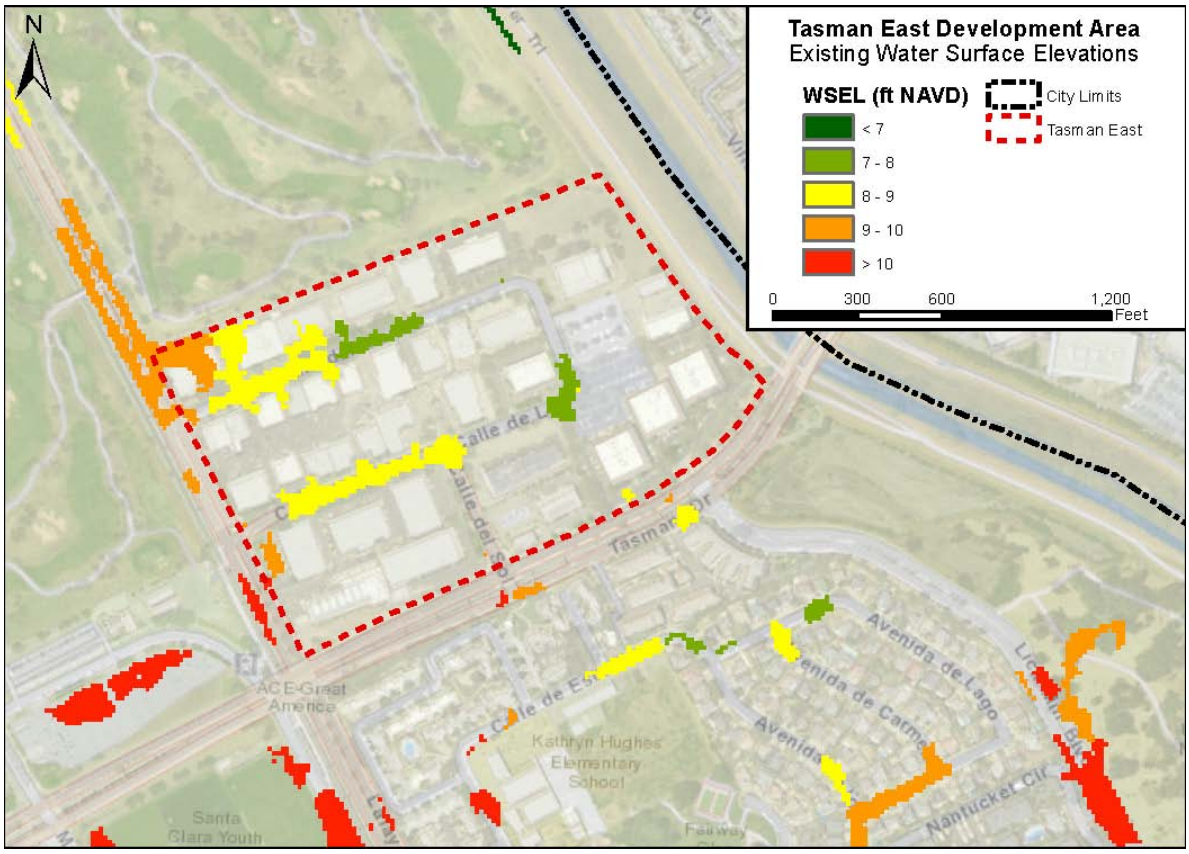

Figure 3. Existing Base Flood Elevations at Project Site Using SDMP Model

In the proposed condition scenario, the site will be graded and the buildings pads will be raised above the BFE. This includes potentially raising the east side of the site to tie an extension of Lick Mill Road into the new development to the north. Thus, with ground elevations at the site raised, the flow path for overland flow from the south to north will be blocked. Approximate ground surface elevation increases for the post-project condition are shown in Figure 4.

Figure 5 shows the resulting overland post-project water surface elevations assuming no changes to the storm drain system. Figure 6 provides a comparison of post-project base flood elevations to pre-project base flood elevations in the site vicinity. Green shading indicates a decrease in base flood elevation and orange shading indicates an increase of less than 0.1 foot, both of which can be considered an insignificant impact. The water surface impact at Lafayette Street is greater than 0.1 foot because the flow path at the northwest corner would be blocked by the raised ground elevation leading to a greater volume of overland release remaining on Lafayette Street. The flooding extents are not significantly impacted, however, as the additional flow remains within the right of way. Because the overland flow path at the northwest corner of the site would be blocked, improvements to the storm drain system could then be considered to offset any significant off-site effects of the development.

By adding a catch basin on Lafayette Street that connects to the existing storm drain system on Calle del Mundo, off-site flood impact can be mitigated as shown in Figure 7. The maximum local increase in BFE is 0.3 foot, but this is limited to and contained by the existing street right-of-way.

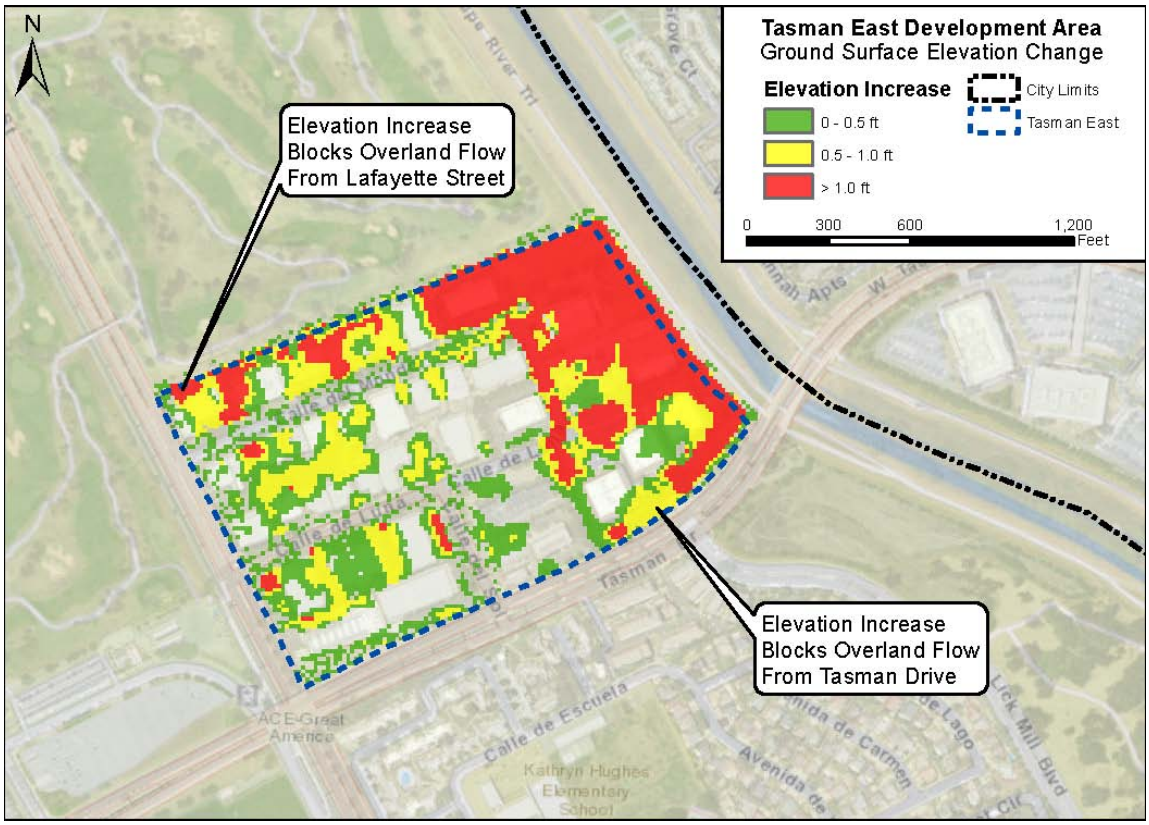

Figure 4. Project Condition Ground Surface Elevation Changes

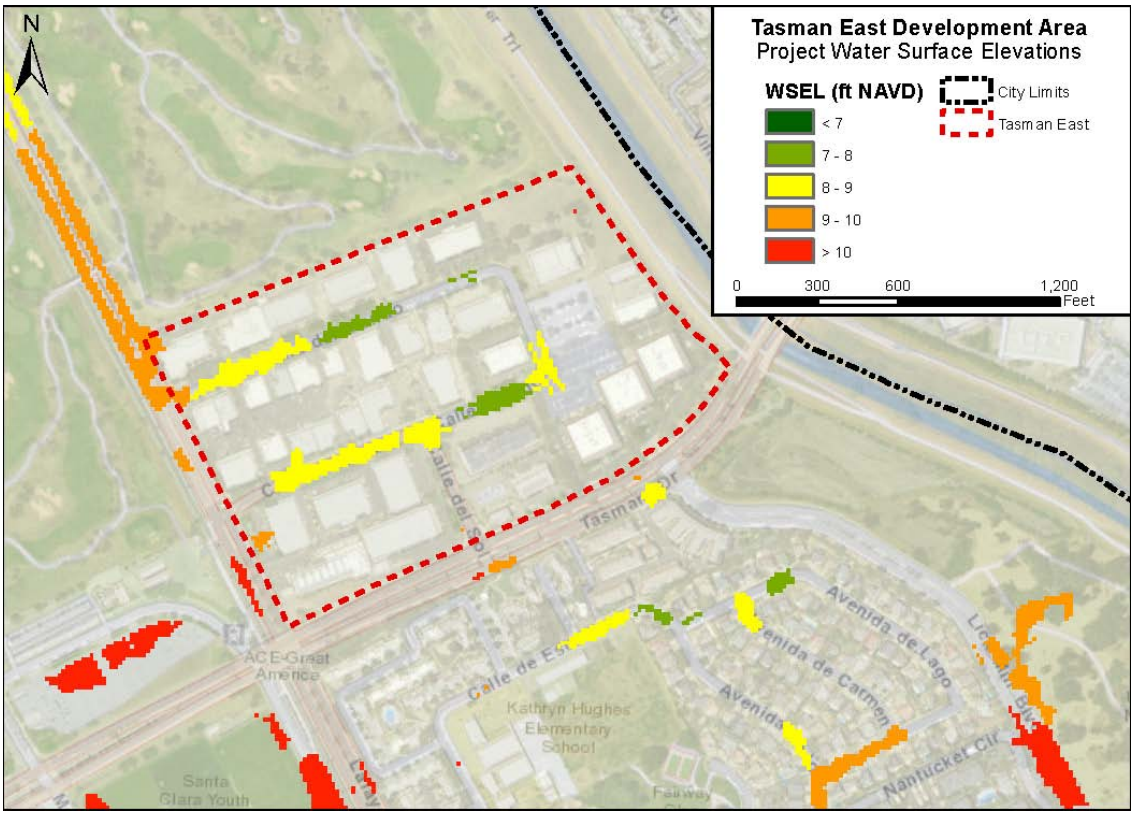

Figure 5. Post-Project Base Flood Elevations at Project Site Using SDMP Model

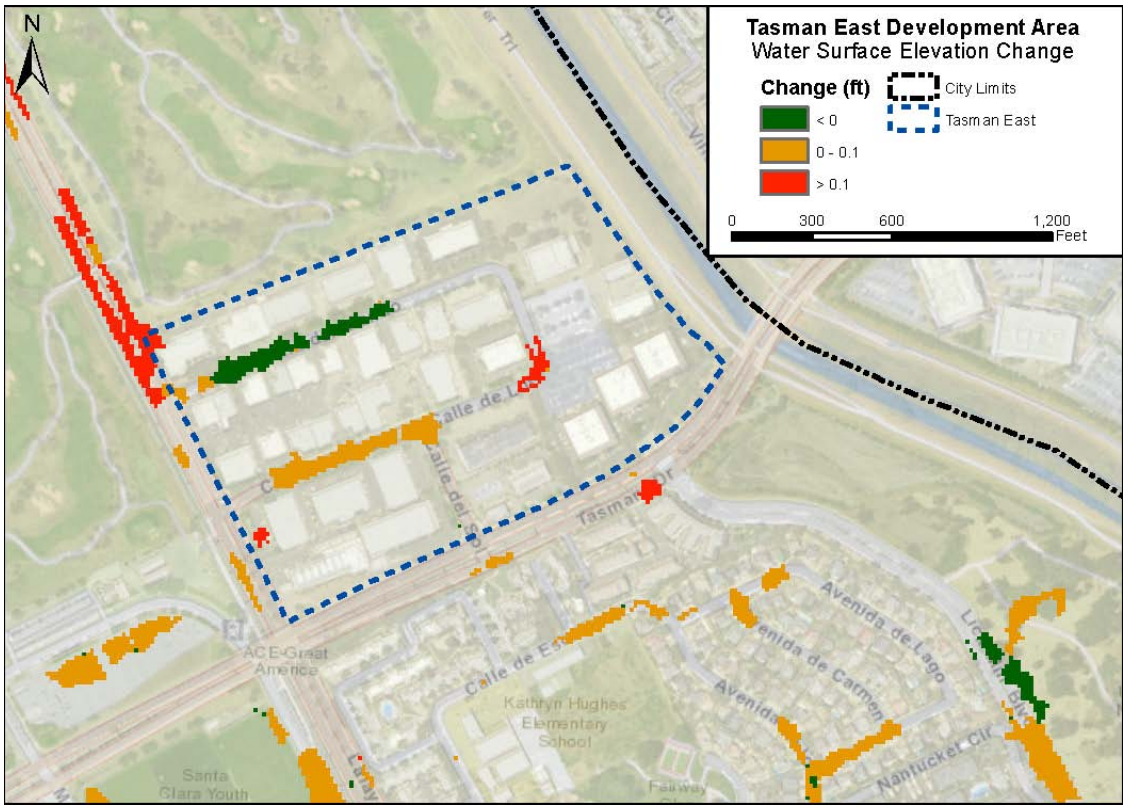

Figure 6. 100-Year Hydraulic Impacts without Mitigation

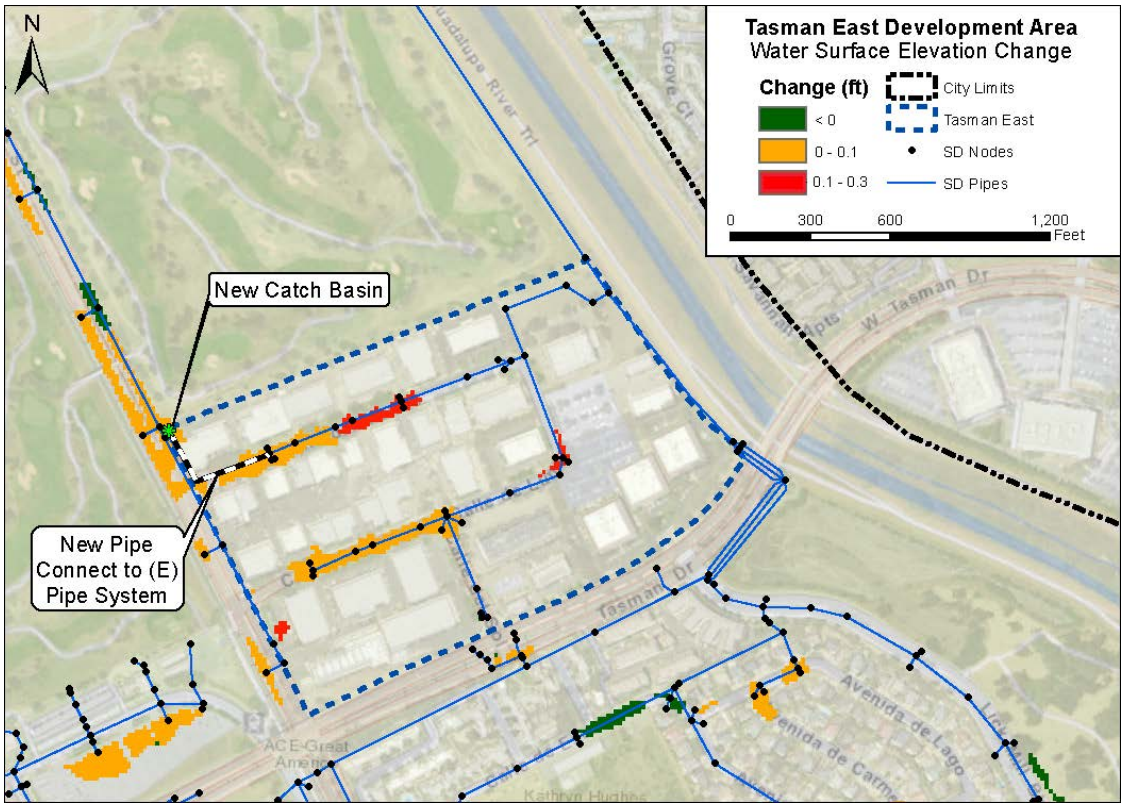

Figure 7. 100-Year Hydraulic Impacts with Mitigation Measures

To the south of the project site is an existing residential development with its own separate drainage system and to the north of the project site, a large mixed use development is planned on the site of the existing golf course. In the future, it is expected, projects downstream (north) of the project site, such as the redevelopment of the golf course, will be designed to have no impacts to upstream water surface elevations and therefore will cause no negative impacts to the Site. In addition, future upstream projects can impact the project site only by significantly altering the existing hydrologic (i.e. flow path) conditions.

The placement of fill to mitigate Impact 1 would not affect mapped flood hazards upstream or downstream of the project site. Limited storm drain modification within the development area would provide for a *Less than Significant Impact with Mitigation Incorporated* to the regulatory floodplain.

Impact 3: Alter existing drainage patterns, including streams and rivers, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding inside or outside of the plan area

Finding: Less than Significant

Since the development area, as well as the surrounding area that currently lies within regulatory floodplain area, is already developed, there is relatively little potential for altered drainage patterns or an increase in runoff rate or volume. Within the East Tasman Specific Plan area itself, current development is mostly commercial and light industrial. The proposed high density residential development will likely consist of comparable impervious area as to the existing land uses. Coupled with changes to the street system within the development area (including an extension of Lick Mill Blvd and the widening of Casa de Luna), the proposed condition increases the existing peak runoff rate by approximately two percent (less than 1 cfs). This relatively minor change in runoff to the existing drainage swale does not cause any significant increase in flooding downstream of the project boundary based on post-project modeling.

Furthermore, the possible (optional) conversion of the existing open channel drainage ditch at the toe of the Guadalupe River levee to a concrete box culvert does not have a significant impact to stormwater flowrates or depth. To assess the conversion of open channel to concrete box culvert, the model uses a lower Manning's n roughness value associated with the conversion to concrete and a 12 foot wide by 4 foot deep rectangular section (or two parallel 6 foot wide sections) that would minimize upstream impacts. Flow is not significantly altered in the remaining downstream portion of the open channel, as the new culvert minimally increases flows from 110 cfs to 115 cfs. This neither increases flow depths significantly, nor does it impact operation of the Eastside Detention Basin and Pump Station.

Therefore since the risk of increased surface runoff is negligible the project would have a *Less than Significant* impact.

Impact 4: Alter existing drainage patterns, including streams and rivers in a manner that would result in significant erosion inside or outside of the plan area

Finding: Less than Significant

Since the specific plan area and vicinity is already developed, there is little potential for an increase in erosion. The increase in runoff induced by proposed development is insignificant. The mildly sloping and thickly vegetated drainage swale to the east (at the toe of the Guadalupe River levee) currently carries approximately 110 cfs to the Eastside Detention Basin. The modeled increase in runoff caused by the proposed development is 5 cfs (approximately 4% of the total flow) and does not create a significant increase in channel velocity relative to the existing condition.

While the conversion of the open drainage channel to a culvert would approximately double velocities to 3 feet per second in the flow path, because the slope is relatively mild, the flow velocity is unlikely to be erosive at the transition from culvert to the existing downstream open channel.

Therefore, since the risk of increased erosion is negligible the project would have a *Less than Significant* impact.

Impact 5: Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;

Finding: Less than Significant Impact with Mitigation Incorporated

While the proposed development itself does not create additional stormwater runoff that would by itself exceed the capacity of the storm drain system at Lafayette Street, the placement of fill associated with the development would block overland flow and without that release, the runoff tributary to the Lafayette Street storm drain system is increased. The previously suggested mitigation measure, adding a catch basin connected to the existing system within the development area, provides an alternate path for flow that would have entered the development area prior to placement of project fill and simultaneously mitigates this impact.

Therefore, with the previously described storm drain modification, the project has a *Less than Significant Impact with Mitigation Incorporated* impact.

Impact 6: Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.

Finding: Less than Significant

The project site is located within the inundation area of two major dams, Anderson Dam and Guadalupe Dam. The site is located 26 miles northwest downstream of Anderson Dam and 17 miles downstream of Guadalupe Dam. The site is not within the inundation boundaries of the Alamaden, Chesbro, Lexington, Stevens Creek, Uvas, or Vasona Dams. The Santa Clara Valley Water District (SCVWD) performed an analysis of the effects of Anderson Dam failure in 2009. This analysis resulted in an expected maximum inundation depth of 9 feet (elevation 19.9 feet) at the project site within 9 hours and 18 minutes after dam failure. These results assume that the dam is at full capacity during failure for the inflow design flood. The dam, however, is currently kept at a maximum depth of about 68 percent full due to a recent SCVWD seismic analysis.[1] The California Department of Safety of Dams determined that the dam may experience significant damage in an earthquake and the water level should remain about 25 feet below the spillway until seismic retrofits can be completed. The currently estimated date of completion is 2021. Due to the high water surface elevations occurring with a dam failure, designing the project to withstand dam inundation is infeasible.

Furthermore, SCVWD performed an analysis of the effects of Guadalupe Dam failure in 2014. This analysis resulted in an expected maximum inundation depth of 5.7 feet (elevation 13.3 feet) at the project site within 14 hours and 13 minutes after dam failure. These results assume that the dam is at full capacity during failure for the inflow design flood. The Guadalupe Dam will soon be the subject of a seismic upgrade after a 2011 engineering study found it to be at risk during a large earthquake. Due to this seismic risk,

[1] *Anderson Dam Seismic Stability Study*. Santa Clara Valley Water District. July 2011.

the dam is currently operated with a restricted reservoir water level of 601 feet compared to its normal pool elevation of 619 feet.

While the project site is subject to deep inundation should Leroy Anderson Dam or Guadalupe Dam fail catastrophically, both dams are inspected twice a year by the District in the presence of representatives from the California Division of Safety of Dams and the Federal Energy Regulatory Commission and both reservoirs are managed to prevent significant damage during a maximum credible earthquake. So while potential inundation resulting from catastrophic dam failure could damage property and proposed structures within the project site and pose a severe hazard to public safety, the probability of such failure is extremely remote and therefore not considered a significant hazard.

The project site is located in a FEMA designated Zone X (shaded) indicating the area is protected by the accredited Guadalupe River levees. In response to historical flooding of Guadalupe River, the Santa Clara Valley Water District (SCVWD) completed a project in 2009 that improved the Guadalupe River's protective levees and provided 100-year conveyance capacity. An accredited levee system is a system that FEMA has determined meets the design, data, and documentation requirements of 44 CFR 65.10.

The Guadalupe River levees are designed to meet the requirements of 44 CFR 65.10, thus providing one-percent-annual-chance flood protection for the site. Levee overtopping and in particular levee breach and failure could potentially be catastrophic and inundate the specific plan area with flood waters at greater depths than indicated on the FIRM; with consequent flood damage more significant than if the levee was not there. To maintain FEMA accreditation, however, the levees require regular maintenance and periodic upgrades so as to retain the level of protection shown on the FIRM. Accredited levees must continue to meet the NFIP minimum design, operation, and maintenance requirements as described in 44 CFR 65.10. So while failure of the levee protecting the area could result in damage to property and proposed structures at the project site, continued maintenance and regular inspection of the levee system makes significant risk of damage, injury, or death due to levee failure very unlikely. The low probability of failure makes the risk of loss, injury, or death less than significant; as it is highly unlikely that the levee will fail in the 100-year event.

Therefore, the project would have a *Less than Significant* impact with regards to inundation by dam or levee failure.

Impact 7: Expose people or structures to inundation by seiche, tsunami, or mudflow.
Finding: Less than Significant

The resonant oscillation of water in an enclosed body of water is a seiche. San Francisco Bay is considered to be an enclosed body of water and is in the general vicinity of the project site. However there are several existing levees positioned between the bay and the site that would dampen any effects of a seiche. There are no lakes or other enclosed bodies of water adjacent to the project to produce seiche events that could affect the project site.

The Association of Bay Area Governments (ABAG) produces Potential Tsunami Area Inundation Maps for the Bay Area. The project site is located significantly far enough away from the ocean where tsunami events would not affect the project site.

Landslides and mudflows tend to occur in steeply sloped areas. The project site is flat and is not down-slope of any steeply sloped areas. ABAG Hazard Maps for both Landslide and Debris Flow show that the project site is located neither within an identified landslide or mudflow hazard area nor near one.

Therefore, the project would have a *Less than Significant* impact with regards to inundation by seiche, tsunami or mudflow.